Abstract—Can we reliably predict human behavior using Artificial Intelligence? Can traditional methods of Ethology, such as an ethogram, be implied to achieve this goal? This is the aim of this study which used observational data collected from ambulatory addictology patients of a district general hospital, using traditional methodological tools of Ethology (ethograms). Observed versus predicted data after adequate training of an appropriately built neural network correlated strongly (Pearson two tailed) and did not differ significantly (t-test). We conclude that Neural Networks may, under defined methodological circumstances, reliably predict human behavior.

Keywords—Artificial Intelligence, Neural Networks, Human Behavior.

I. INTRODUCTION, AIM AND PROBLEMATIC

Purpose of this work is to show the interest of modeling behavior with a mathematical tool rather neglected by researchers of Ethology: artificial neural networks. Although there have been numerous attempts to model human behavior in the past, to the best of our knowledge, none of them proposed to derive input variables for the neural networks from ethogramms, combining a classical Ethological tool with a computational modelling one.

Contemporary animal behavior research often tries to combine the methods and insights of the experimental approach of comparative psychology with the field observational approach of ethology. Unlike comparative psychology that originated in North America as a branch of experimental psychology, classical ethology is a branch of biology that originated in Europe and uses observational rather than experimental methods; it is interested first and foremost in the naturally occurring behavior of animals rather than in differences between species, especially in intelligence and learning. While the study of learned behavior is both important and immediately applicable to human psychology, these behaviors do not have an evolutionary basis beyond the neural capacity to learn. Behavior is defined as any resultant of an internal and / or external state of the observed living being. The term "resultant" can account for its mathematical and geometrical nature and includes the concept of "sense".

Accepting a definition for "behavior" means accepting that this definition depends on the tradition of research and on the subject we seek to understand/explore. Ethology is a major discipline in the research of behavior. This important discipline is focused on the study of external factors. Internal factors such as physiology or memory are studied only indirectly as they are more difficult to be objectively assessed than external factors such as age, sex, species, reactions to stimuli.

The role of internal factors for modeling behavior has been and remains the subject of lively debate. Neural Networks may effectively mimic such internal processes e.g. learning. We demonstrate that back-propagation learning of Artificial Neural Networks, a process of Biomimicry, contributes in the output of efficient predictions of human behavior. Although this work is a work on ethology and will be based on observable data (= external factors), we will try to demonstrate that the use of a tool such as artificial neural networks, which mimic an internal process of capital importance for the formation and expression of behavior, such as learning, is likely to address the lack of representation of internal processes in ethological models.

II. MATERIALS AND METHODS

Observations were collected from a total of 127 ambulatory patients at a district general hospital, over a one-year-period Observation site was the refectory of the establishment, a place mostly visited by patients and secondarily by families or visitors. At the entrance, there was a machine distributing soft drinks, coffee, chocolate and different types of sodas. The refectory measured 3 x 4.5 m. There was a single door entry / exit to the side and it was accessible by the central corridor of the hospital, on the ground floor and not far from the main entrance (see diagram below). In this space, limited by its size, there were seats all around a table with periodicals and brochures with medical information. The walls were decorated with anti-tobacco and anti-alcohol posters. There was one window opening to the garden. Facing the aisle however, a window allowed unhindered observation from outside.
The choice of this observation site was conditioned by
the fact that the office of the observer (which served as an
observatory) allowed unhindered and discreet observation
because the office window was a one-way mirror that
allowe the observer not to be seen during observation.
Another reason was the fact that outpatients spent their
time there and this same place served for meetings and
socialization, or simply relaxation.

Aim of the study was to predict, using artificial
intelligence, who was to be found when doing what at this
specific place.

A. Subjects

For convenience it was decided to observe ambulatory
patients in good general condition, without disabilities or
other constraints which may affected their mobility, and
as such it was decided to follow only patients admitted in
the Addictology Department. These "patients" had already
had the phase of physical withdrawal behind them and
had agreed to sign an agreement " of principle " with the
Department, to initiate an additional period of
hospitalization until the addictology specialist physician (and most importantly, the patient himself) gained the
impression that the addiction problem was more or less
solved. This period was generally three to four weeks and
was attached to the initial period of physical withdrawal (about a week), during which the patient agreed not to
leave his room.

During the period called "psychological withdrawal",
patients were free to follow a number of activities held
regularly by the service: occupational therapy, theater,
music... But participation in these activities was not
mandatory and patients participated only if they wished.

B. Collection of data.

Ethogramms’ data were suitably processed before
input in the Artificial Neural Networks. These parameters
are both ethological (eg. Commitment to a discussion or
not ...) and biometric (age, sex ...) as well as external
e.g. climate (temperature, rain ...). In other words, we
try to identify most of the factors that are likely to
influence the choice of the individual to perform certain
actions such as occupy the refectory, or not, engage or not
a conversation etc. Data obtained from these observations
were used as input variables for training of neural
networks. Some individuals did not return and this made
work difficult because there was a lack of output
variables (variable output) for a first comparison of the
results after training. To this difficulty is added the fact
that about 40% of the inaugural observations did not meet
all criteria. It was decided to use only factsheets that were
duly filled so as not to have recourse to statistical
techniques to fill in the missing data. Thirty out of 127
observations met all criteria and could be exploited.

The methodology used was that conventionally used
in ethology: establishing an ethogram. The ethograms
were in their majority collected using paper and pencil
and later the services of a software. We felt that the latter
offered a better accuracy in the collection of data.

All ethograms were transcribed in Excel form before
being transformed into ASCII file a necessary step before
inputing for training purposes into a suitably created
artificial neural network software.

After training of the networks, behavior during
occupation of the premises by the observed subjects was
compared to the output of Neural Networks (NN)
attempting to predict behavior.

Observed versus Produced (NN output) behaviour was
compared using t-test and two tailed Pearson correlation.

III. RESULTS AND CONCLUSIONS

No significant differences between observed and
artificial intelligence outputs were noted using Student's t-
test.

A. Data

Ethogramms were obtained thus describing observed data
as in the following example:

Observer: DK
Ethogram: Cafeteria
Location: CH
Species: F
Duration: 5 Min
Interval: 15 Sec
Weather: 743mBar
Area: Paris
Collection Date: 03-03-2011 11:47
Total # of Behaviors Observed: 4
Inactive was the behavior you saw the most
Figure 2.

Table I shows an excerpt of observed (observe) data, elaborated after ethogramms, and NN elaborated data (produit) at two hour intervals of observations. The sex of the patient visiting the premises during the observation period and whether socializing or not (Discussion) is observed and compared to NN produced data: where 0 = certain behavior NOT observed, 1=observed, 2=new behavior, not included among those studied.

A significant correlation of the data was observed when using two tailed Pearson test (excerpt below).

B. Correlations

Observed versus Predicted Behavior in the observational time frame 10-12h: Pearson 0.623**(p<0.01).

Observed versus Predicted sex of the person to occupy the premises in the observational time frame 10 – 12h Pearson 0.605**

Observed versus Predicted Socialization (Discussion) of the observed person occupying the premises in the observational time frame 10-12h Pearson 0.512**

** Correlation is significant at the 0.01 level (2-tailed).

C. Prediction Accuracy

Prediction accuracy was defined as the Number (Nacc) of accurate predictions divided by the Number of observed behaviours (Nobs) . Mean accuracy of predictions was .91. Cumulated results are condensed in the histogram below:

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In agreement with previously published data from other research centres, this work provides further evidence that Artificial Neural Networks can be a powerful tool in the prediction of human behaviour. We also provide evidence of the usefulness of observational data as input variables for Neural Networks, collected using Ethogramms, a methodological tool of Ethology. Subtle behaviour or emotions such as aesthetic preferences may be best described using Ethogramms. Neural Networks account for internal processes such as learning.

REFERENCES